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Indian Standard

METHOD FOR BEAM UNNOTCHED IMPACT TEST FOR GREY CAST IRON

(First Revision)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

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(First Revision)

Methods of Physical Tests Sectional Committee, SMDC 3

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Indian Standard

METHOD FOR BEAM UNNOTCHED IMPACT TEST FOR GREY CAST IRON

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 February 1985, after the draft finalized by the Methods of Physical Tests Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1969 to evaluate the shock resistance of certain types of cast iron. While reviewing this standard, the Sectional Committee decided to revise this standard incorporating SI units.

0.3 This standard is based on ISO 946-1975 'grey cast iron beam unnotched impact test', issued by International Organization for Standardization.

0.4 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS:2-1960*.

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1. SCOPE

1.1 This standard prescribes the method of conducting beam unnotched impact test on grey cast iron containing graphite in flake form.

1.2 It does not apply to austenitic and malleable cast iron.

2. PRINCIPLE OF TEST

2.1 The test consists in breaking by single blow from a swinging hammer under prescribed conditions, an unnotched machined cylindrical test piece

*Rules for rounding off numerical values (*revised*).

resting freely between supports. The energy absorbed is determined by taking the difference between the kinetic energy of the hammer immediately before fracture and its residual energy after the fracture of the test piece.

3. TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 The impact strength of the grey cast iron is the apparent energy absorbed in fracture denoted by the symbol *KG*, and is expressed in joules (*see also* Appendix A).

3.2 Impact Modules — The ratio $\frac{KG}{V}$ where *KG* is the apparent energy of rupture expressed in joules, and *V*, volume of test piece between supports expressed in cubic centimetres.

4. SYMBOLS USED

4.1 The following symbols have been used in this standard:

Symbol	*Description*
l	Length of test piece
d	Diameter of test piece
A	Initial potential energy of the testing machine
L	Distance between supports
r	Radius of curvature of supports
α	Angle at tip of hammer
R	Radius of curvature of hammer
V	Speed of hammer at instance of striking
KG	Apparent energy absorbed in fracture

5. METHOD OF CASTING TEST BAR

5.1 The test bar shall be cast separately and shall be poured at the same time and from same ladle of metal, as the casting it represents.

5.2 The test bar shall be cast in dry sand and its structure shall be entirely grey.

5.3 Each test bar shall be spaced apart from its neighbour, any other casting in same mould by a minimum distance of 50 mm.

5.4 The test bar shall not be removed from the mould if its temperature is above 500°C.

5.5 If the castings represented are heat treated, the test bar shall be heat treated at the same time and under the same conditions as the castings.

6. DIMENSIONS OF CAST TEST BAR

6.1 The test bar shall be cast as a cylindrical bar having a diameter of 30^{+2}_{-0} mm and a minimum length of 150 mm.

7. TEST PIECE

7.1 The test piece shall be well machined with a good finish and shall have the dimensions given in Table 1.

TABLE 1 DIMENSIONS OF TEST PIECE

SYMBOL	DIMENSION	NOMINAL VALUE mm	TOLERANCE mm
l	Length of the test piece	120	± 2
d	Diameter of the test piece	20	$\pm 0{\cdot}2$

7.2 If any test piece shows defective machining or obvious lack of continuity in the metal, it shall be discarded and replaced by another test piece.

7.3 If it is found necessary to carry out the impact test on test piece not of the standard size specified in **7.1** it may be useful to calculate the 'impact modulus'. Appendix A gives details of calculating the impact modulus.

8. TESTING MACHINE

8.1 The testing machine shall be constructed and installed steady and rigid.

8.2 The testing machine shall comply with the following requirements (*see* also Fig. 1):

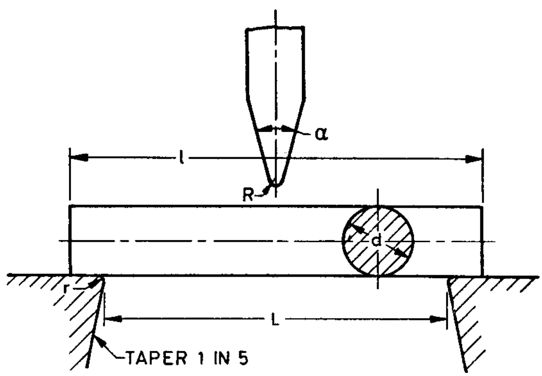
Characteristic	*Requirement*
Initial potential energy of the testing machine A	50 ± 2 J
Distance between supports L	$100^{+0.5}_{-0}$ mm
Radius of curvature of supports r	1 to 1·5 mm
Taper of supports	1 : 5
Angle of tip of hammer α	$30° \pm 1°$
Radius of curvature of hammer R	2 to 2·5 mm
Speed of the hammer at the instant of striking	3·60 to 4·20 m/sec

8.3 In case the test is conducted on test pieces other than what is given in Table 1, it should be ensured that the machine where such tests are conducted should be capable of making appropriate adjustments of the supports.

8.4 The plane of swing of the hammer shall be vertical. The machine shall be constructed so that the loss of energy (such as from translation, rotation or vibration) in the machine framework during a test is negligible.

8.5 The height of the centre of percussion above the point of impact of the hammer shall be 3±3 mm.

8.6 The accuracy of the graduation of the scale of the machine shall be ±0·5 percent of the maximum striking energy of the machine.



Ref Symbol	*Nominal Dimension*	*Machining Tolerance*
l	120 mm	±2 mm
d	20 mm	±0·2 mm
L	100 mm	+0·5 mm −0 mm
r	1 to 1·5 mm	—
α	30°	±1°
R	2 to 2·5 mm	—

FIG. 1 BEAM IMPACT TEST (UNNOTCHED)

9. TEST REQUIREMENTS

9.1 The test piece should lie squarely against the supports with the plane of symmetry of the hammer midway between them.

9.2 The test shall be carried at ambient temperature.

10. METHOD OF TESTING AND REPORTING OF TEST RESULTS

10.1 At least four test pieces shall be fractured for each test.

10.2 After breaking four test pieces under the conditions prescribed under **9.1** and **9.2** the arithmetic mean $\bar{X}$ of the values obtained and the range of test results (R) that is difference between the maximum and the minimum values of test results shall be calculated.

10.2.1 If R is not more than 0·4 $\bar{X}$, the impact value shall be expressed as:

$$KG = \bar{X}$$

10.2.2 If R is greater that 0·4 $\bar{X}$, the test shall be repeated with a fifth test piece kept in reserve. The arithmetic mean $\bar{X}_1$ of the values obtained and range, R_1 shall be calculated.

10.2.3 If R_1 is not more than 0·5 $\bar{X}_1$, the impact strength shall be expressed as:

$$KG = \bar{X}_1$$

10.2.4 If R_1 is greater than 0·5 $\bar{X}_1$, the test shall not be considered significant enough to give an acceptable value of KG.

10.3 The test shall be discarded if obvious flaws on the surface or on the broken face of certain test pieces have made it extremely difficult to obtain the required number of values.

APPENDIX A

(*Clause* 7.3)

CALCULATION OF IMPACT MODULUS FOR NON-STANDARD TEST PIECES

A-1. The impact modulus is the ratio KG/V where KG is the apparent energy absorbed in fracture expressed in joules and V, volume of test piece between supports expressed in cubic centimetres.

A-2. Within acceptable practical limits and for the same grade of cast iron, impact modulus is independent of the diameter of the machined test pieces if the following conditions are observed:

a) The test pieces are of proportional dimensions $l=6d$,

b) The distance between supports is proportional to the dimensions of the test piece $L=5d$,

c) The value of KG/A remains above 0·4,

d) The diameter d is between 12 and 29 mm, and

e) All the other conditions of test and particularly the velocity of impact V and the diameter of the original bar or the mass of the test piece remain unchanged.

A-3. The impact modulus of the standard test piece ($d=20$ mm) is calculated according to the following formula:

Impact modulus, (joules/cm^3) $=\frac{1}{10\pi}\times$ apparent energy absorbed in fracture (in joules).

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